MCom

The impact of Education on the economic growth of developing countries: the case of Togo.

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ABSTRACT

It is acknowledged in the literature that investment in human capital, more precisely education, has a positive impact on economic growth. However, studies have shown that this could not be proven in every country or region. As the 4th principle of the Sustainable Development Goals, education can be a contributing factor to development. This paper examines the impact of education on economic growth in Togo, a developing country, using time series data spanning from 1971 to 2018, which were sourced from the World Bank Database. It is set out to explore the existence of a relationship between education variables and economic growth proxied by the GDP per capita growth; the returns of investment in education; and the impact of the quality of education on growth. The study employed the ARDL ECM estimation method to examine the relationship between the variables used.

Although the findings establish long-run co-integration among the variables, the long-run coefficients are statistically insignificant. However, it is evidenced that a change in the gross enrolment rate, mainly in primary education, and government expenditure in education, have a negative relation with GDP per capita growth. Key findings in the short-run estimation reveal that there is a positive and statistically significant relationship between enrolment in primary and secondary education, completion rate in secondary education, and GDP per capita. Notwithstanding the significance of the long-run estimates, the study recommends improved investment in education at all levels of education and a higher reliance on professional education that will quickly train students to enter the job market and perform revenue-generating activities.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

1 Chapter 1 - Introduction

1.1 Background of the study

The African continent is generally considered to be "developing", especially the Sub-Saharan Africa region. It is the fastest-growing continent in demographics and economic terms (United Nations, 2015). The continent's economic growth was approximately 3.2% in 2018, higher than Latin America (0.7%) or Europe and Central Asia (1.6%) (United Nations, 2015). Between 1960 and 2018, the Sub-Saharan Africa population grew from 227 million to 1 billion with a sustained annual average growth of 2.7%, and by 2060 the population is expected to reach 2,8 billion (World Bank Data, 2018). Additionally, over 40% of the continent's population is under age 15, and nearly 22% between 15 and 24 years of age, which makes Africa the continent with the largest youth population in the world (World Bank Data, 2018). Several studies see this demographic growth as an opportunity for development through a growing labor force and a large emerging consumer market, while others see it as a risk as the population will strain fewer available resources. But the actual development of the continent will depend on the policies enacted by governments in terms of human capital development, especially in education, among others.

Anderson (2014) says that "*In the 1970s, East Asia invested in its young people's human capital, it enabled the region to realize its demographic dividend, contributing to a 6% surge in GDP and a quadrupling of per capita income in some countries. That is why we ended up with what we call the 'Asian tigers' and that's how Asia has been the point of growth since then*". His article reveals that investing in youth and education could indeed contribute to economic growth through an increase of the Gross Domestic Product (GDP) per capita, as shown by the Asian Tigers[1] example. Other authors support the same idea by offering some favorable features to growth such as a rising share of the working-age population increasing physical capital per worker Zelleke, Sraiheen, and Gupta (2013), a rising Total Factor Productivity Aka, Akitoby, Tahari, and Ghura (2004), and a rising human capital in the form of rising education (Canning, Raja, and Yazbeck, 2015).

[1] The Four Asian Tigers also called the Asian Dragons are the high-growth economies of Hong Kong, Singapore, South Korea, and Taiwan. Fuelled by exports and rapid industrialization, the Four Asian Tigers have consistently maintained high levels of economic growth since the 1960s and have collectively joined the ranks of the world's wealthiest nations. All four Asian Tigers have a highly educated and productive work force compared to others in the region.

In 2015, the United Nations member states reunited to establish new development goals to be achieved by 2030. These are the Sustainable Development Goals that aim at ending poverty, protecting the planet, and improving the lives and prospects of everyone, everywhere. Education is the fourth Sustainable Development Goal (SDG4) and calls to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Quality education is one of the targets and indicator of the SDG4 and provides that the completion of secondary schooling is a minimum level requirement for an individual to be able to compete in an increasingly globalized economy. While Sub-Saharan Africa made the most significant progress in primary school enrolment among all developing regions – from 52% in 1990 to 78% in 2012 – significant countries' disparities remain (World Bank Data, 2018). The primary school enrollment rate for Mali and Niger stood at 61% and 65% respectively in 2017, while Benin and Namibia's rates stood at 97% in the same year (World Bank Data, 2018). The United Nations UNDP (2015) also emphasizes that achieving inclusive and quality education for all reaffirms the belief that education is one of the most powerful and proven vehicles for sustainable development. Therefore, education appears to be a key driver of development and is considered crucial given the continent's young and fast-growing population. Other studies such as Lee-rife, Malhotra, Warner, and Glinski (2012) and Omoeva, Hatch, and Sylla (2014) also demonstrate that education will reduce the gender inequalities witnessed on the continent by preventing early marriage, especially for girls. According to a report of the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2013), with all girls receiving secondary education, early marriages will reduce by 64%, early birth by 59%, and birth rate per woman by 42%.

However, in terms of workforce, the continent appears to be in dire need of skilled workers in the strategic sectors needed for its development and economic growth, such as infrastructure, manufacturing, agriculture, and technology. The Global Human Capital Report (2017) of the World Economic Forum reports that "*Employers across the region already identify inadequately skilled workforces as a major constraint to their businesses, including 41% of all firms in Tanzania, 30% in Kenya, 9% in South Africa and 6% in Nigeria. This pattern may get worse in the future with the demographic boom. In South Africa alone, 39% of core skills required across occupations will be wholly different by 2020*" (World Economic Forum, 2017a). Therefore, it is evident that not only the continent needs to invest in its human capital

through increased investment in education to address the skills shortage, but it also needs to produce workers whose skills will fit in the economic growth strategies.

As per The Future of Jobs and Skills in Africa (2017) report from the World Economic Forum, Sub-Saharan Africa has the highest deficit in terms of human capital development, which includes among others the primary and secondary enrolment rates, the quality of education, and the staff training (World Economic Forum, 2017b). This deficit is further reflected in the unemployment rate on the continent, which stood at 6.09% in 2018, above the global rate of 4.9%, or the labor force participation rate of only 67% (World Bank Data, 2018). On the same note, productivity growth has shrunk over the years to 1.7% in 2017 from 2.9% in the 2000s. Furthermore, the working poverty rate, which is the proportion of the population engaged in the labor force but earning less than the poverty threshold, has increased from 23.8% in the 2000s to 30.4% in 2017 (Adolwa et al., 2017). These numbers, with a constant labor force proportion, denote an inadequacy of the workforce skills to the job opportunities generated by the economies. In other words, there is indeed a workforce available, but its labor does not generate sufficient income to allow an exit from poverty. In essence, the above leads to the thinking that an approach to resolving poverty through education would need to be holistic, and integrate into investment in education other factors such as the studies' adequacy to the needs in these countries.

1.2 Problem definition

This study focuses on Togo, a developing country in West Africa, one of the African countries that have engaged in the Free Primary Education (FPE) system in an attempt to fulfill one of their Millennium Development Goals (MDG), which is to achieve universal primary education. The FPE system means the abolition of public school fees for students of the age of going to Primary School. For the Government, it implied the recruitment and training of new teachers and the provision of essential schooling materials in public schools in need. The Togolese education system was inherited from the colonial period and has not known significant changes since then. It has four levels: six years of primary school, four years of secondary school, three years of high school, and tertiary education through the 2 State Universities and other private tertiary institutions. Scholars also have access to vocational education, technical or professional training.

The Togolese education system was affected by the socio-economic crisis of the nineties that led to the cease of international aid to the country. The government was then unable to provide proper education programs and quality public infrastructure for several years. Public spending in education declined to 3.4% of the GDP in 2005, compared to a high of 5.8% of GDP in the early 1980s (World Bank Data, 2018). However, this public spending has slightly increased and stabilized around 4% of the GDP from 2008, when the country regained its political stability and confidence from international development organizations (Kudjoh, Adjaro, Agbenoto, and Akakpo, 2014). Reforms of the education sector were engaged, notably the implementation of the FPE system, one of the 17 new UN global SDG. However, government spending on education, as a percentage of government expenditure, has been declining from 19% in 2008 to 16% in 2011 and 15% in 2016 (World Bank Data, 2018). As of today, the education system in Togo is marked by a high level of drop-out and deficient quality of programs and infrastructures (Kudjoh et al., 2014). The diagnosis of the sector called RESEN supervised by UNESCO and published in 2014, revealed persistent weaknesses such as a high level of dropouts, repeaters, and analphabetism, as well as low quality of learnings and a growing quantitative and qualitative in-adequation of the education supply to the needs of the economy (Kudjoh et al., 2014).

On the other hand, the GDP growth of the country alternated over the past years between negative and positive values but has stabilized around 5% over the past ten years. Following the 1990s socio-economic crisis where the GDP growth was negative for several years, the country regained and has sustained positive economic growth since 2009 (World Bank Data, 2018). In 2018 the GDP grew by 4.7% and was expected to grow further by 5% in 2019 (IMF, 2018). The GDP per capita growth has followed the same trend and has been positive since 2008. In value terms, it fluctuates around US$ 600, which is half of the Sub-Saharan Africa region level of US$ 1,572 as of 2018. Therefore, as per the World Bank definition, Togo is a low-income country[2] with a population living in poverty, which, in turn, has a direct effect on the households' spending on education. There is also the impact of demographic growth as the population has almost doubled since the eighties (Global partnership for education, 2019). The number of children of the age of going to school estimated at 2.2 million in 2010 will increase

[2] Low income countries have a GDP per capita below US$ 995 as per the World Bank definition.

to 3.3 million by 2025 (Kudjoh et al., 2014). This increase will have repercussions on the capacity of schools to avail, the number of teachers to recruit, and on public spending in education. (Kudjoh et al., 2014).

So, given the country's profile in terms of education and economic growth, it is interesting to interrogate and analyze the linkages between the two variables. As of 2018, Sub-Saharan Africa GDP per capita is US$ 1,572, more than double the one of Togo. It is worth establishing if the government policies in investment in human capital such as government spending in education and FPE have a positive impact on the wealth of the population and, at the national level, on the economic growth of the country. Thus, this dissertation investigates the following questions:

a) What is the link between education and economic growth in Togo?
b) What are the returns of education on economic growth in Togo?
c) Does the quality of education have any impact on economic growth?

1.3 Statement of research objectives

The objective of the study is to examine the effect of education on economic growth in Togo. The specific objectives include:

a) To examine the link between education and economic growth in Togo.
b) To examine the returns of education on economic growth in Togo.
c) To examine the quality of education in Togo and its effect on economic growth.

1.4 Justification of the study

Africa has the youngest population, while it is currently considered the least developed continent. This combination is a problem that cannot be resolved if the growing and young population is not educated to be a skilled workforce that will hold the development goals of the continent. Governments have experienced limitations in creating wealth for their population. Without being given the tools to work and make a living, the population in poverty may remain in this status, ailing further the development of the continent. Although it is widely accepted that investing in human capital contributes to economic growth, it is necessary to test whether the current education policies implemented in Togo, are adequate to create such economic growth and perhaps reveal if and how the private sector's input is required. The FPE was

implemented ten years ago now, and it will be worth reflecting on its actual gain. Thus, this research makes the following contributions. First, it establishes the key factors that drive education programs to succeed and make a positive impact on economic growth. Second, it makes recommendations on education policy to the government of Togo, which can also serve other countries with similar challenges. Lastly, it unveils the role of quality education in reducing poverty in developing countries.

1.5 Organization of the study

The study is organized as follows: the next chapter provides a sample of the literature on the relationships between education and economic growth. Chapter 3 describes the methodology used for the study, from the research approach to the research design. Chapter 4 discusses the results of the empirical analysis, and Chapter 5 summarizes the findings, concludes the study, and makes recommendations.

2 Chapter 2 - Literature review

2.1 Introduction

The literature on the relationship between the quality of education and its impact on economic growth dates back to 1961. Seminal studies present evidence that investment in human capital has a role in economic growth through the increase of the marginal productivity of educated workers in the determination of national product. Similarly, other studies contend that an incremental year of schooling produces returns of the investment in human capital. Meaning that the more years of schooling, the higher the return on the investment in education. Recent literature shows that only a high-quality education yields great results. The literature review of the study is structured as follows. First, literature that analyzes the links between human capital and economic growth is discussed, followed by literature on the positive returns of education on economies. Lastly, the chapter concludes with an analysis of literature on the conditions that lead to quality education that makes a positive impact on economic growth.

2.2 Overview of government expenditure in Togo

Since 2009, government expenditure in Togo has been above the GDP level, from 109% of the GDP in 2009 to 111% of the GDP in 2018. The primary spending for government is the trade of goods and services, which represents 74% of the GDP, followed by health expenditure representing 6.6% of the GDP in 2018. The government expenditure on education represents 5% of the GDP and 15% of the total government expenditures as of 2016. From 2008 to 2016 the level of expenditure on each level of education changed as follows: expenditure on tertiary education reduced from 20% to 17%; expenditure on secondary education reduced from 35% to 16%; and expenditure on primary education increased from 40% to 64% in 2016 (World Bank Data, 2018). These changes prove a shift of the government's policies toward increased primary education finance, though at the detriment of the other two levels. It is worth noting however that the Togolese government expenditures in education, as a percentage of GDP, is close to the level of the Sub-Saharan Africa region which is 4% as of 2016, or the one of European Union of 4.6% of the GDP as at 2017 (World Bank Data, 2018).

2.3 Theoretical Framework: Education and Economic Growth

To provide a framework for interpreting the results of empirical studies, there are two main streams of thought of economic growth: the classical theory of economic growth and the new theory of economic growth. The classical theory regards Labor productivity as an exogenous factor, and therefore, does not take into consideration the effect of education or human capital development on economic growth (Pelinescu, 2015). Classical economists such as Adam Smith and Thomas Malthus considered that the main drivers for economic growth were the accumulation of investments or profits, and any change in these variables would explain the long-term progression of the economy. This theory was an individualistic point of view of the society which promoted free competition to individualistic ends and less government interference.

However, the new theory of economic growth corrects this omission by giving importance to human capital or education on economic growth. Indeed, the neoclassical theory, using the Cobb-Douglas equation, gives the production or output as a function of physical capital and labor. It argues that GDP per capita will continuously increase because of people's pursuit of profits or economic gains. Here, knowledge, innovation, and technology are considered drivers of economic growth. Knowledge especially is considered an asset with continuous returns contrary to physical capital, for example. In this theory, competition is seen as a limiting factor to profits, hence the need for individuals to acquire knowledge, innovate, and develop new technologies to increase their profits. The more individuals want high profits, the more they grow their human capital. This transition of putting human capital at the center of the economic growth lays down the basis of several empirical studies on the causality or effect of education on national economic growth and development.

As an illustration, the microeconomic studies on labor (Rivkin, Hanushek, and Kain (1998); Krueger (1999); Attias-Donfut and Barnay, (2002)) usually show a positive impact of education with returns, whereas macroeconomic studies on economic growth (Benhabib and Spiegel (1994); Barro and Sala-i-Martin (1995)) conclude on little or no relationship between the two variables. This contradiction is investigated by Krueger and Lindhal (2000), who focus on two main errors, the measurement error and the omitted variable bias, also evidenced in the Barro-

Lee (1993) dataset[3]. Using new estimates of the initial stock of human capital, and change in human capital in an attempt to sort the measurement error, their investigation reveals that education has an impact on economic growth, but also that there is a possible reversed causality as economic growth could lead to increased education. More recent studies like Cohen and Soto (2007) address the measurement error of the previous data such as the Barro-Lee (1993) one by using new education data on years of schooling. It is evidenced in their study that removing the measurement error leads to a significant impact of education on economic growth. The return of an additional year of schooling can increase by 3.8% following a correction of the measurement error (Li, Liu and Zhang, 2012).

Additionally, studies attempting to sort the omitted variable bias like Sala-I-Martin, Doppelhofer, and Miller (2000), Hanushek and Kimko (2000), and Gennaioli, Porta, Lopez De Silanes and Shleifer, (2013) investigate the variables that are robust enough or statistically significant in the education studies. Sala-I-Martin et al. (2004) use the Bayesian averaging of OLC estimates and conclude that primary school enrolment is one of the most significant variables; however, they do not address the measurement error. Their results are to be taken with caution. Furthermore, Hanushek and Kimko (2000) add the variable of school quality, which is a significantly relevant variable as we know now. Measuring the human capital by data collected from mathematics and science tests over 30 countries, they find that the quality of the education variable is positive and statistically significant. Gennaioli, Porta, Lopez De Silanes and Shleifer, (2013) assemble a new sample of 1,503 regions in 82 countries to allow a cross-section analysis on the importance of year of schooling and GDP per capita at a regional level. Adding a fixed effect data on the regions, their results show that five additional years of schooling lead to an increase in annual growth of 1% without the fixed effects and 3% with the fixed effects. Another problem is the endogeneity bias checked by Hanushek and Kimko (2000) by regressing the school quality to other variables on government spending, for example. They conclude that the other variables have no strong explanatory power, and as such, there is little evidence of reverse causality.

[3] Barro-Lee (1993) dataset provides educational attainment estimates for 129 countries for 1960–1985. Several updates to the dataset have been made in the subsequent years.

2.4 Empirical Literature

The relationship between education and economic growth has been extensively researched. As early as in the 1960s, Schultz (1961) introduced the notion of investment in human capital, treating, therefore, human beings as capital. He states that by investing in themselves through the acquisition of knowledge and skills, human beings have a way of improving their welfare. As an example, Schultz observed following World War 2 that developing countries were less able to utilize available physical capital for reconstruction than rich countries, and this was due to their low human capital ability to absorb and utilize this physical capital. Therefore, economic growth cannot be determined without taking into account knowledge and skills as a critical investment variable (Schultz, 1961).

Schultz (1961) provides the precursor of the human capital theory, and it has since been studied from various angles. Some studies focused on trying to determine the role of education in economic growth, building on the new growth theory. Pelinescu (2015), using a panel methodology, confirmed human capital as a determining factor of growth and contended that the slow investment in human capital impacts sustainable development (Pelinescu, 2015). The study found a positive relationship between GDP per capita and innovative capacity of human capital proxied by the number of patents, and qualification of employees proxied by secondary school attainment. However, her model failed to correct the heterogeneity of the countries selected, which led to the negative relationship between education expenditure and GDP per capita.

Similarly, Breton (2013) attributes a critical role of education in economic growth when he establishes that both human capital and physical capital are interlinked in the determination of the national product and that each one has a positive effect on the productivity of the other. The mechanism through which education affects economic growth is when educated workers raise national income directly because schooling raises their marginal productivity (Breton, 2013). In an attempt to address the cost-effectiveness of government education expenditures, he observes that for developing countries, private investment in schooling is barely possible, hence the necessity for public funding, especially at the primary and secondary levels. This observation is supplemented by the fact that technologically advanced countries have had a history of free primary education.

The role of education on economic growth, then established, other studies focused on the type of relationship between the two variables. Mincer's (1984) theory starts from a microeconomic standpoint. He states that at a microeconomic level, national wage differences are mostly explained by the volumes of human capital. He further infers that levels of education and productivity are correlated to levels of income, therefore the higher the education, the higher the income. Noting that human capital growth and diffusion is necessary to ensure sustained economic growth, he points out, however, that human capital growth is both a consequence and cause of economic growth (Mincer, 1984), similar to the reversed causality findings of Krueger and Lindhal (2000).

Similarly, Bills and Klenow (2000) attempt to determine whether there is a causal effect between education and economic growth. In their growth model, they add to the physical capital an enhanced estimation of stock of human capital by adding teacher human capital and technology index. They assume prima facie that education has an impact on economic growth, but their objective is to quantify or measure the level of this impact on the correlation of the two variables. They also assume that the mechanism through which human capital raises economic growth is through increased adoption of new technologies. This is close to the findings of Benhabib and Spiegel (1994) regarding the benefit of education on the absorption of new technologies. Benhabib and Spiegel (1994) determine that economic growth increases the demand for schooling; hence education is a consequence of economic growth. Their findings also reveal that education accounts for one-third of the economic growth; however, the impact via technology adoption is small.

Coming now to the African continent, research has also attempted to establish the role education played on the economic growth of African countries. However, these studies' results are to be taken with caution, given the lack of data or reliable data in many countries. Bloom, Canning, and Chan (2006) investigate the connection between education, specifically tertiary education, and economic growth in the context of Sub-Saharan Africa. Using estimates on education variables instrumented, i.e., average years of education with literacy rates and average year of tertiary education with Doctors per capita, they find a significant and positive relationship. According to their research, an additional year of schooling raises economic growth by 0.6%, and doubling the average year of tertiary education increases the growth by 0.1%. However, there are few variables used, exposing the research to the omitted variable bias, and critics of

the reliability of their instruments. Hoeffler (2002), on the other hand, investigates the possible reasons for Sub-Saharan Africa's curtailed economic growth by regressing several variables, including education through the Barro-Lee (1993) year of schooling data. As mentioned earlier, this data does not address the measurement error bias, and this could explain the result of Hoeffler (2002), which found no significant impact of education on economic growth.

The relationship between education and economic growth is mostly recognized these days through various mechanisms. Research has focused on the intensity of this relationship, revealing a return of investing in human capital or education. Barro-Lee's (1993) dataset has been extensively used in education and growth literature. This initial cross-section dataset has been updated several times by themselves during the last two decades. Nevertheless, Robert Barro has been among the first to quantify the return on investing in education. Starting with human capital proxy variables like primary and secondary school enrolment rates, he then expands his research variables to the average years of schooling. Barro and Lee (1993) average years of schooling variable data collection was later proven to be less significant in the most recent studies.

Later in the 21st century, Barro and Lee (2011) return to examine data on educational attainment in 145 countries and its distribution by age group and gender, this time from 1950 to 2010. This update has often been used in the literature as it allows more precise inferences on the links between education and economic growth. The results indicate that an additional year of education generates a rate of return of 12%, and more precisely that the rate of return of schooling is higher for the secondary and tertiary education level (R. J. Barro and Lee, 2011). These results could show that, although FPE increases the enrolment rate of children, it does not necessarily lead to improved individual income, and therefore economic growth at a national level.

Mankiw, Romer, and Weil (1992), in their contribution to the empirics of economic growth, estimate the determinants of economic growth with a Solow model, which distinguishes human capital from physical capital with a microeconomic standpoint. They demonstrate in the research seeking to explain cross-country differences in income per capita, that the accumulation of physical capital and population growth has a more significant impact on income when the accumulation of human capital is taken into account. This result indicates that

returns on physical capital are correlated to an accumulation of human capital, and therefore education, savings, and population growth variables explain cross-country differences in income per capita. To conclude, they add that education policies, which vary from a country to another, will ultimately be a determinant of cross-country differences (Mankiw, Romer, and Weil, 1992). However, contrary to Barro (1991), they did not make a distinction between Primary education and Secondary education.

This theory is later on criticized by Bernanke, Rotemberg, Klenow, and Rodriguez-Clare (1997), who argue that secondary schooling alone is not adequate to estimate investment in human capital. They suggest that it should be a sum of primary, secondary, and tertiary education because most countries have higher enrolment rates in primary than in secondary or post-secondary. Summing up the three levels significantly decrease the estimate of investment in human capital. They concur with the positive effect of education at a microeconomic level on individual workers but contend that Mankiw et al. (1992) have overestimated this effect.

Patrinos and Psacharopoulos (2002) analysis on Returns to Investment in Education in Latin America and the Caribbean region, established a return on investment of an additional year of education to a 35% higher GDP per capita (Psacharopoulos and Patrinos, 2002). For the researchers, education investment behaves like an investment in human capital. Their study shows some limitations, however, as they contend that it is true at a micro-economic level but not at a macro-economic level. In 2015, Harry A. Patrinos confirmed this limitation, adding that for developing countries, there is a need for more research and the use of a quasi-experimental model (Patrinos, 2015).

Thomas and Burnett (2013) took another approach, which is cost-based (Thomas and Burnett, 2013). Their analysis reviewed the benefits of primary education and estimated the economic cost associated with large populations of out-of-school children. The 2013 report updates economic cost estimates to reflect the latest data from the UNESCO Institute for Statistics (UIS), further develops the estimation methodology, and expands the estimation exercise to a set of 20 low- and middle-income countries. The data is collected from sampled countries where data are available over a period from 2000 to 2013. They evaluated the economic cost of out-of-school children to justify the need for universal primary education, giving support to FPE policies. Moreover, they have proven that the estimated economic gain from achieving

universal primary enrolment exceeds the estimated increase in public spending required to enroll those out-of-school children in primary school. According to them, the richer the country, the higher the cost of out-of-school children is (Thomas, M., Burnett, 2015).

Using the Cobb-Douglas production function regression, Benhabib and Spiegel (1994) do not find that variations in stock of human capital substantially influence variations in income per capita. However, they still argue that education, not as a factor of production but rather as a factor, enables the implementation of new technologies and increases physical capital productivity. So not only education or human capital development is correlated to economic growth, but it also positively impacts it in most cases, from the microeconomic level with increased individual welfare to the macroeconomic level with the increase of national product. Investing in education is equivalent to investing with an expected return, which income impacts the national product eventually. However, several economists' voices rose at the observation of persistent cross-country differences in economic growth despite policies promoting education in the developing countries since the 1980s. And the main conclusion of their research is that quality weighs more than quantity when it comes to education.

Unlike the empirical literature discussed above, Hanushek and Woessmann (2008) introduce the learning or the notion of the quality of the human capital when estimating the impact of education on a country's GDP. By doing so, they address the omitted variable bias of the previous studies. Indeed, the researchers have gathered the skepticism around the lack of economic outcome of education investments and have introduced a measurement of the human capital abilities through international tests in Mathematics and Science. They used regional data from the new data set of Cohen and Soto (2007) on sample countries for the eight regions: Asia, Sub-Saharan Africa, MENA, Southern Europe, Latin America, Central, and Northern Europe, and the Commonwealth OECD from 1960-2000. The common point of the sampled countries is their participation in international student achievement tests. Taking the example of the growth differences in East Asia and Sub-Saharan Africa, they established that these growth differences are entirely related to differences in cognitive skills and, therefore, that the assumption that an additional year of schooling is equivalent to higher knowledge and skills is incomplete. These findings could explain the low GDP per capita in Togo compared to the one of the Sub-Saharan Africa region, despite their same literacy level. Their conclusion also suggests the lower significance of the average years of schooling (when test scores variable is

added) as compared to the school quality variable. And one standard deviation increase in school quality is related to a 1.3 to 2 % higher rate of economic growth.

Similarly, Romer's (1990) empirical research investigates the link between basic literacy, and rate of income growth and rate of investment. He uses the initial level of income and the initial level of literacy in a sample of 112 countries from 1960 to 1985. He adds to the model the log of newsprint consumption per capita and the number of radios per 1000 inhabitants in 1960. The results show that qualitative data initially omitted in the education and growth studies, are relevant, and suggest that the initial level of literacy contributes to explain the investment rate and, consequently, the rate of income growth (Romer, 1990). However, these results are exposed to measurement errors because the level of income comes in the calculation of growth rate, and the level of literacy is correlated to the level of income.

Coming to studies focused on Africa, Glewwe, Maiga, and Zheng (2014) examine recent studies that estimate the impact of education on economic growth and explain the methodologies differences that lead to difficult estimation of the impact of education. They identify econometric problems in most of the studies and conclude that cross-country data cannot precisely estimate the impact of education on economic growth. They also analyze the relevance of the quality rather than the quantity of education in the economic growth discussion and provide evidence that it is indeed more relevant (Glewwe, Maïga, and Zheng, 2014). However, their study also suffers from measurement error bias, given the lack of reliable data for the African continent. They use three influential pieces of research on education regressions results focusing on Sub-Saharan Africa, naming Mankiw, Weil, and Romer (1992), Barro and Sala-I-Martin (2004) and Hanushek and Woessmann (2008), and provide evidence that lower growth rate in Sub-Saharan Africa is partly due to lower quality of education. However, these conclusions can be more convincing if similar data were available for more, if not all, countries in Africa. Only a few African countries were tested in each research.

2.5 Chapter Summary

The numerous theories and extensive research on the subject all agree that education or investment in human capital is related to economic growth but that the returns can be higher at different levels of education and according to the policies implemented by the country. This

literature brings us to investigate the same in the case of Togo, with its change of policy to FPE, increased expenditure on primary education, and reforms in the education sector. We would like to see whether these reforms effectively translate into economic growth. The methodology of the study is explained in the following chapter.

3 Chapter 3- Methodology

3.1 Introduction

This chapter provides an overview of the research methodology used in this study. It is composed of three main sections. The first one gives the research approach and presents the assumptions retained to conduct the study. The second one details the research design with the description of the data, the empirical model, the description of the variables used, and finally, the estimation approach. The last section concludes the chapter. With the use of data extracted from the World Bank Database and a selection of variables related to education and economic growth, the study attempts to respond to the research questions.

3.2 Research Approach

The study intends to quantify the impact of education or investment in human capital on economic growth. Quantifiable data on the education parameters are available and support the use of a quantitative approach through an econometric model that informs on the relationship between the variables. The variables being time series, the study performs a time series analysis with a unique set of tools and methods. This choice is informed by the fact that time series, as opposed to cross-sectional data, often violate the assumptions of conventional statistical methods and often present a correlation between variables (Erica, 2019).

The assumption made for the study is that human capital development through education has a positive impact on the economic growth of a country. This impact is driven by the increased productivity of the educated individuals who have a higher level of human capital and, therefore, a higher probability of engaging in revenue-generating activities. Although the impact can derive from both the public and private sectors, the study is oriented towards public education services. The objective being to identify the outcome of the education policies undertaken so far and the quality of the services provided, and give an indication of the direction they should take if not already taken.

3.3 Research Design

A time series analysis and modeling was performed to investigate the relationship between education factors and economic growth here proxied by the GDP per capita growth.

3.3.1 Data sources and sample period

For the subject study, secondary data extracted from the World Bank database on school attainment, income, and labor from 1971 to 2018 were used. A limitation of the analysis was the presence of missing data in almost all variables. This fact has led to the need to do multiple statistical imputations to estimate the values of the missing data. The unit of analysis here is the country Togo and its population above the age of 15, which represents the active population. The choice of the active population is dictated by the need for the research of a population that is, or could be, educated and engaged in income-generating activities.

3.3.2 Empirical Model

In terms of modeling, of the two broad approaches that emerged, i.e., time domain and frequency domain, this study used a time-domain approach. The time-domain approach models future values as a function of past and present values through a regression (Woodward and Gray, 2020). The model of this research is a multiple time series type of model as it involves one dependent time series and other independent time series (Shin, 2017).

The time series multiple regression specification is as follows:

$$G = f\,(ENPE, ENSE, ENTE, ENGR, UNEM, GXED, GXSE, GXTE, GXPE, LFPR, DRPE, DRSE, COPE, COSE, REPE, RESE, PTTE, PTSE, PTPE, ENPR, ENPU) \quad (3.1)$$

Where G, the dependent variable, is the GDP per capita growth, and the others are the independent or explanatory variables described as follows. ENPE is the primary school enrolment ratio, ENSE is the secondary school enrolment ratio, ENTE is the tertiary education enrolment ratio, UNEM is the unemployment rate, GXED is the government expenditure on education rate as a percentage of total government expenditure, GXSE is the government expenditure on secondary education rate as a percentage of total government expenditure on education, GXTE is the government expenditure on tertiary education rate as a percentage of total government expenditure on education, GXPE is the government expenditure on secondary

education rate as a percentage of total government expenditure on education, LFPR is the labor force participation rate, DRPE is the dropout rate in primary education, DRSE is the dropout rate in secondary education, COPE is the completion in primary education, COSE is the completion in lower secondary education, REPE is the repeaters rate in primary education, RESE is the repeaters rate in lower secondary education, PTTE is the pupil-teacher ratio in tertiary education, PTSE is the pupil-teacher ratio in secondary education, PTPE is the pupil-teacher ratio in primary education, ENPR is the gross enrolment rate in private school and ENPU the gross enrolment rate in public school.

The choice of the GDP per capita growth as the dependent variable is explained by the fact that it is a variable available for a broad range of countries and is easily measurable for cross country comparison, which could be useful for future research. Three general equations were used to attempt to respond to the research questions:

Equation 3.2 investigates whether or not there is a significant link between the GDP per capita growth and education in Togo:

$$G_t=\beta_0 + \beta_1 ENPE_t + \beta_2 ENSE_t + \beta_3 ENTE_t + \beta_4 ENGR_t + \beta_5 UNEM_t + \mu_t \quad (3.2)$$

Equation 3.3 explores whether there are significant returns on investment in education from a government expenditure perspective in Togo:

$$G_t=\beta_0 + \beta_1 GXED_t + \beta_2 GXPE_t + \beta_3 GXSE_t + \beta_4 GXPTE_t + \beta_5 LFPR_t + \beta_6 DRPE_t + \beta_7 DRSE_t + \mu_t \quad (3.3)$$

The next equation is based on the argument that investment in education needs to be done in the appropriate framework and environment to allow the skilled workforce to be absorbed and higher returns. An unplanned education system can reveal itself inadequate to respond to the needs of the country, creating unemployment and human capital flight. Equation 3.4, therefore, attempts to establish the relationship between GDP capita growth and qualitative indicators of schooling in Togo:

$$G_t = \beta_0 + \beta_1 COPE_t + \beta_2 COSE_t + \beta_3 REPE_t + \beta_4 RESE_t + \beta_5 PTTE_t + \beta_6 PTSE_t + \beta_7 PTPE_t + \beta_8 ENPR_t + \beta_9 ENPU_t + \mu_t \quad (3.4)$$

Variables related to the link between GDP per capita and Education

To establish whether there is a significant link between GDP per capita and Education focus is put on school enrolment levels in the country. Several empirical studies of the 90's used school enrolment data to measure educational attainment. Barro (1991) showed evidence of a relationship between human capital and growth, using the school enrollment rates in primary and secondary schools as a proxy to the human capital. Similarly, Mankiw, Romer, Weil (1992) used the secondary school enrollment rate as a proxy to human-capital accumulation in their paper examining the consistency of the Solow growth model with the variation of the standard of living.

Of note is that each one of these studies has focused on enrollment, either in primary or secondary school, not both. This is a limitation in their results as there is a tendency to have a higher level of enrollment at the primary level, which then drops at the secondary, and even more, at the tertiary level. This limitation calls for a distinction between primary, secondary, and tertiary levels of education variables before an evaluation of their sum. It follows the critics of Klenow, Rodriguez-Clare (1997) on the lack of distinction and allows to compare models and make precise findings and recommendations. Depending on the two approaches, the measurement of the impact of education on economic growth can be much different. It justifies the choice to include all three levels of enrollment rates primary, secondary, and tertiary, then the gross level. The addition of the unemployment rate in the first equation is to be able to establish the correlation between the school enrolment rates, unemployment levels, and GDP per capita. This addition could give a good indication of whether an investment in human capital (here proxied with school enrolment) eventually translates into a lower unemployment level.

Variables related to the returns of Education on the GDP per capita

The returns on education measurement are essential at a country level for policy determination. So far, in Togo, a lot of government expenditure on education has focused on Primary School, to respond to the Millennium Development Goals initially, and now the Sustainable Development Goals. However, this is at the detriment of other levels of education, i.e., the secondary and the tertiary. It is beneficial to establish whether the government expenditures at each level and grossly have an incidence on the GDP per capita growth. It is generally perceived that a higher per capita translates into higher consumption and growth. To establish the returns of the investment done in education, the variables chosen are the government expenditures on education, and at primary, secondary, and tertiary schooling levels. Barro (1989) estimates that

expenditures on education and defense are more like public investment likely to affect the private sector's productivity and, therefore, private investment. Siddiqui and Rehman (2017) established in their study that government expenditure on education, to proxy human capital formation, positively affected economic growth in East and South Asia.

The additional variable in this equation is the labor force participation rate, which correlated with the government expenditure, would be a good indication of the returns of the investments done in education. The labor force here is the population ages 15-64 that is economically active and therefore supply labor for the production of goods and services in the country. The higher the participation, the higher the production and growth.

Variables related to the quality of Education

Measures of the quality of education have been and are still widely debated. However, there is a global consensus that mere school quantity or access is not enough to improve economic conditions. Various UNESCO researches evidenced that learners could not take advantage of school places even if they are available or could drop out of school if the learning outcomes do not correspond to their future needs or if the learning environment does not fit their realities. To represent the quality of education in this study, the variables chosen are the completion rates, the repeaters rates, and the number of pupils per teacher. Cognitive skills, measured for example, by test scores, are equally important to define an education of quality, as demonstrated by Hanushek and Woessmann (2008). However, the usual cognitive skills variables are not available for the country under study. The variables chosen are quantifiable and acceptable determinants of education quality. UNESCO framework on the variables of the quality of education has five dimensions: the learners' characteristics, the context, the enabling inputs, the teaching and learning, and the outcomes (UNESCO, 2004). Furthermore, the dimensions are associated with indicators on the context, the input, the output, and the process (Scheerens, Luyten, and Van Ravens, 2011). The variables used in this research mainly touch on the output indicators (completion rates, repeaters), and also on the input indicators through the pupil per teacher variables. Then to allow a comparison of the impact of private education versus public education on the GDP per capita growth, the enrolment rates in private and public education have been added to this final equation.

3.3.3 Estimation approach

The approach applied for the estimation used a conventional time series data analysis framework that involves a stationarity test, and long-run and short-run analysis.

3.3.3.1 Unit root analysis

The unit root test tests the stationarity of a distribution. It allows to see whether a change in time will lead to a change in the shape of the distribution of variables, here time series. To analyze time series and allow forecasting, they need to be stationary. If a time series has a unit root i.e. a stochastic trend, it shows a systematic pattern that is unpredictable. This leads to issues such as spurious regressions and misleading statistical relationships between times series variables. For this study, the Augmented Dickey-Fuller (ADF) test, with intercept only, was used for each equation to determine whether there is stationarity.

3.3.3.2 Cointegration analysis

After performing the stationarity test, the data suggested that the series are integrated of order 0 and 1, and therefore stationary at level and first difference. For a set of time series to have a long-run relationship, they have to be cointegrated. If the time series have a long-run relationship, it implies that even with shocks in the short-run affecting the movement of the single series, they would converge with time to equilibrium. The notion of cointegration arose from the concern around spurious regressions in time series (Andrew J. Buck, 1999). The cointegration analysis is still part of procedures to investigate the ability to apply the models to a set of time series with reliable results. As a rule of thumb, if a linear combination of two or more I(1) series generates an I(0) order of integration, there is cointegration between the variables. For this study, the Bounds cointegration test introduced by Pesaran, Shin, and Smith (2001) was conducted. It allows cointegration testing with variables of different order I(0) and I(1).

The Bounds cointegration test hypothesis are as follows:

- H0: there is no cointegrating equation
- H1: reject H0

When the F-statistic is greater than the critical value for the upper bound I(1) at 5% level of significance, the null hypothesis is rejected, meaning that there is cointegration. If the models are found to be cointegrated, the conclusion is that they can be combined in a linear fashion and they exhibit a long-run relationship.

3.3.3.3 Long-run and short-run analysis

The performance of the cointegration analysis reveals whether there are short-run and long-run relationships between the variables. All the equations of this research indicated that the series are cointegrated, and this informed the estimation method used. The study used an error correction model (ECM) derived from an autoregressive distributed lag method (ARDL) that integrates both short-run and long-run components. The process started with identifying the maximum lag length (k) necessary to perform the estimation. An error in the lag length choice can lead to reducing the precision of the model, i.e., loss of degrees of freedom, statistically insignificant coefficient, and multicollinearity (Lütkepohl, 2005). The Akaike information criterion (AIC) was retained to identify the lag length as it is adapted to small sample sizes, it is known to choose the correct order more often and it is designed to minimize the forecast error variance (Lütkepohl, 2005). Afterward, the ECM procedure was run to observe the p-values of the coefficients generated in the model.

The lag length procedure indicated a lag k of 1 to be sufficient to estimate the model. The ARDL ECM models are specified as follows, with the GDP per capita (G) as the dependent variable and single vector:

Equation 3.2

$$D(G)_t = \beta_0 + \sum_{i=1}^{p} \beta_i \ D(G_{t-i}) + \sum_{i=0}^{q} \alpha_{10} \ D(ENPE_{t-i}) + \sum_{i=0}^{q} \alpha_{11} \ D(ENSE_{t-i}) + \sum_{i=0}^{q} \alpha_{12} \ D(ENTE_{t-i}) + \sum_{i=0}^{q} \alpha_{13} \ D(ENGR_{t-i}) + \sum_{i=0}^{q} \alpha_{14} \ D(UNEM_{t-i}) + \gamma \ (ECT1_{t-1}) + \mu_t \quad (3.5)$$

Equation 3.3

$$D(G)_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \ D(G_{t-1}) + \sum_{i=0}^{q} \alpha_{20} \ D(GXED_{\ t-1}) + \sum_{i=0}^{q} \alpha_{21} \ D(GXSE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{22} \ D(GXTE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{23} \ D(GXPE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{24} \ D(LFPR_{\ t-1}) + \sum_{i=0}^{q} \alpha_{25} \ D(DRPE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{26} \ D(DRSE_{t-1}) + \gamma \ (ECT2_{t-1}) + \mu_t \quad (3.6)$$

Equation 3.4

$$D(G)_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \ D(G_{t-1}) + \sum_{i=0}^{q} \alpha_{30} \ D(ENPR_{\ t-1}) + \sum_{i=0}^{q} \alpha_{31} \ D(ENPU_{\ t-1}) + \sum_{i=0}^{q} \alpha_{32} \ D(COPE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{33} \ D(COSE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{34} \ D(REPE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{35} \ D(RESE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{36} \ D(PTTE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{37} \ D(PTSE_{\ t-1}) + \sum_{i=0}^{q} \alpha_{38} \ D(PTPE_{t-1}) + \gamma \ (ECT3_{t-1}) + \mu_t \quad (3.7)$$

Where β_0 is an intercept, β_i the coefficient of the lagged value of the independent variable, μ_t a white noise, α_{ii} the coefficient of the regressor, and D the differenced value of the regressor. This part of the equation represents the short-run relationship. ECT is the error correction term representing the long-run relationship, and its coefficient γ is the speed of adjustment, i.e., the speed at which G returns to equilibrium in the long-run following a change in the explanatory variable.

The cointegrating equations or long-run models are specified as follows for the three equations respectively:

$$ECT1_{t-1} = G_{t-1} - \beta_0 - \alpha_0 ENPE_{t-1} - \alpha_1 ENSE_{t-1} - \alpha_2 ENTE_{t-1} - \alpha_3 ENGR_{t-1} - \alpha_4 UNEM_{t-1} \quad (3.8)$$

$$ECT2_{t-1} = G_{t-1} - \beta_0 - \alpha_0 GXED_{t-1} - \alpha_1 GXSE_{t-1} - \alpha_2 GXTE_{t-1} - \alpha_3 GXPE_{t-1} - \alpha_4 LFPR_{t-1} - \alpha_5 DRPE_{t-1} - \alpha_6 DRSE_{t-1} \quad (3.9)$$

$$ECT3_{t-1} = G_{t-1} - \beta_0 - \alpha_0 ENPR_{t-1} - \alpha_1 ENPU_{t-1} - \alpha_2 COPE_{t-1} - \alpha_3 COSE_{t-1} - \alpha_4 REPE_{t-1} - \alpha_5 RESE_{t-1} - \alpha_6 PTTE_{t-1} - \alpha_7 PTSE_{t-1} - \alpha_8 PTPE_{t-1} \quad (3.10)$$

In order to test the adequacy of the model generated, a series of tests were performed, including a residuals serial correlation test, a residuals heteroskedasticity test, and a residuals normality test.

3.3.3.4 Granger causality analysis

The objective of the study being to analyze the relationship between the series, it was opportune to conduct a Granger causality analysis. The Granger test helps to determine whether the past values of a series could cause another one. The null hypothesis of this test says that there is causality. If the p-value is less than the significance level of 5%, then the null hypothesis is rejected. The Granger test is applied on the lagged values of the series to identify the short-run causality. The long-run causality can be interpreted from the error correction term (ECT) coefficient, which, if negative, indicates a long-run convergence to equilibrium. According to studies in the literature review, the introduction of human capital in economic growth's determination has led to empirical studies on the causality of education on national economic

growth. Krueger and Lindhal (2001) and Benhabib and Spiegel (1994) further reveal the existence of a reversed causality, i.e., that education is a consequence of economic growth, whereas Hanushek and Kimko (2000) find little evidence of it. Following the methodology applied by the majority of studies in literature, applying the Granger causality test in this study revealed, beyond the observed correlation between education and economic growth, the magnitude of this relationship and whether there was also evidence of reversed causality in Togo.

3.3.4 Data description

The study used data collected from the World Bank database from 1971 to 2018. The 21 regressors selected are in the field of Education based on the availability of credible data in Togo. Note that the traditional variable of "Years of schooling" was not annual and did not have enough observations, and the one of "test scores" was not available for Togo. There were several missing data, however a multiple imputation technique allowed to estimate the missing values to be able to perform the estimations. Contrary to the listwise deletion or the pairwise deletion methods which are notorious for bias, the multiple imputation technique uses observed data from the dataset to estimate the missing values in a statistical way and provides better estimates. The multiple imputation was performed through the software SPSS by selecting the 22 variables with a minimum percentage missing for variables of 1%. All variables, except the GDP per capita growth, had at least one missing data. The imputation in this technique is done 5 times until a complete dataset is reached.

The World Bank database of development indicators has the oldest and the most complete data on a singular country or region, for each commonly known development indicators. It is the most complete as it sources its data from UNESCO Institute for Statistics, OECD National Accounts data files, IMF datafiles, International Labour Organization ILOSTAT database, and other World Bank researches.

The GDP per capita growth is used to proxy the economic growth in the research. To respond to the first research question on the existence of a link between education and economic growth, variables on enrolment rates at each level of education were used. The research also aims at investigating whether a particular level of education influences more economic growth. To respond to the second research question on the returns of education, variables of government expenditure in education were used. The dropout rate was also used to examine the influence of this loss of investment in education, which could affect the returns. Then the labor force participation was used to examine if an investment in education reflects in a more productive workforce. Finally, to respond to the third research question, variables on the quality of education were selected, naming the pupil-teacher ratios, the completion rates, and the enrolment in private and public schools. The latter is to verify whether private school influences more

economic growth than public school and if the case, inform policymakers on the improvements to make to public schools.

3.4 Conclusion

This chapter presented a summary of the methodology applied in this study to achieve the set objectives. It further outlines a description of the data utilized to answer the research questions in this study, substantiating the sufficiency of the data. The following chapter presents the results and interpretation of the analysis and modeling performed on the variables.

4 Chapter 4 – Empirical results

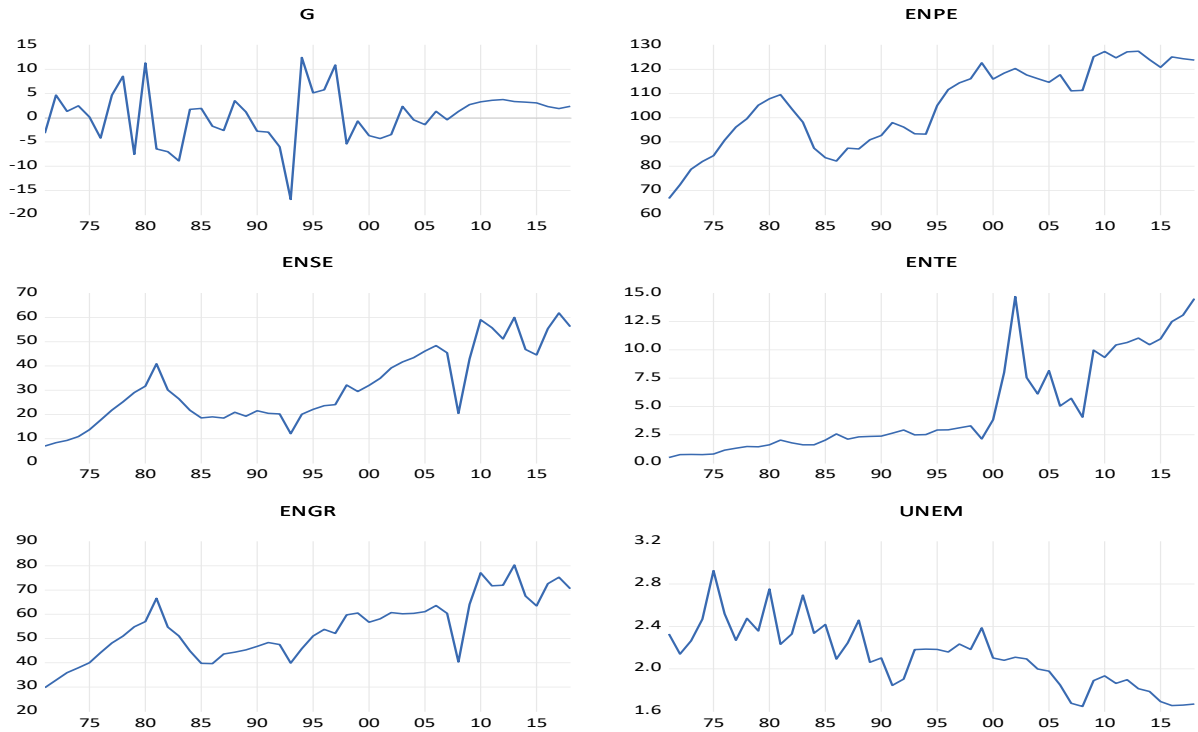
4.1 Introduction

This chapter discusses the findings of the empirical analysis of this research. The main research objective was to investigate whether education has a significant impact on economic growth in Togo. The study also examines the relationship between education and economic growth through two sub-questions; does education generate returns that impact economic growth and does education quality significantly impact individual economic output. The following sections describe the results of the study.

4.2 Descriptive statistics outputs

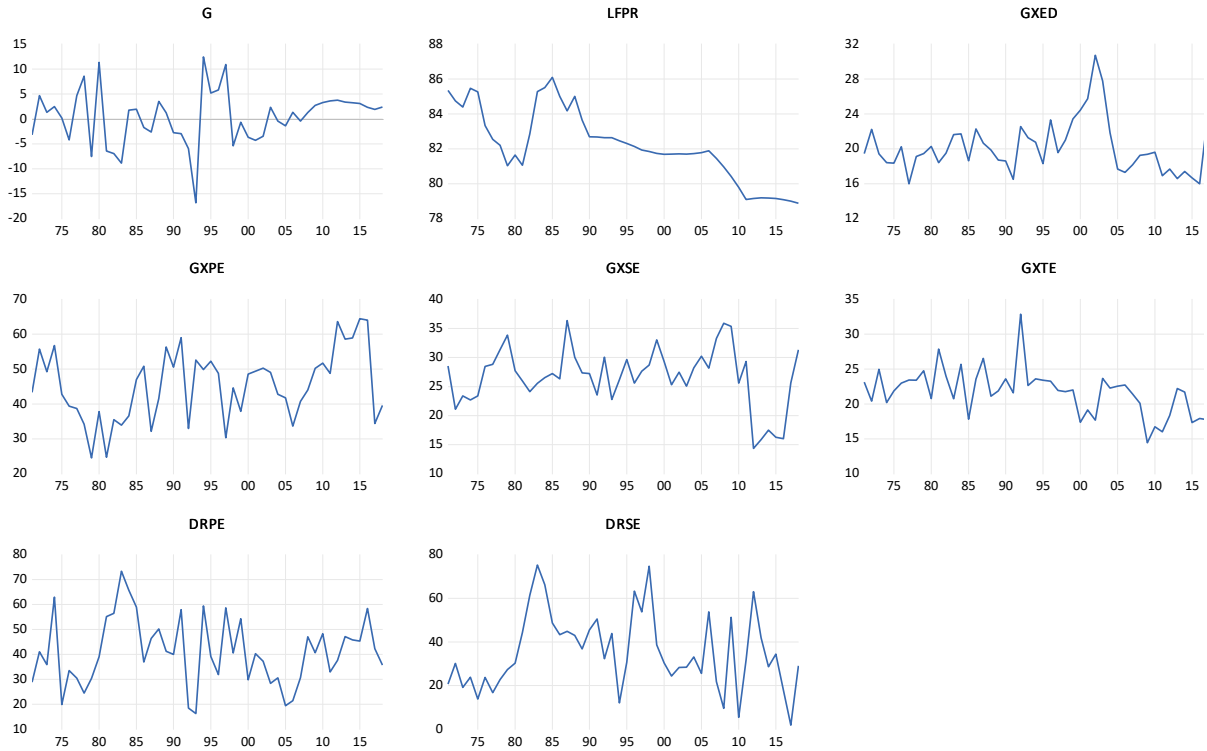
This section describes the findings of the initial observation of the system variables' graphs. Figure 1 below depicts the trend of variables in equation 3.2. For equation 3.2 on the existence of a link between education and economic growth, the education variables have an upward trend except for the unemployment rate. This could be interpreted by the nature of the unemployment rate variable, which is structural and depends on the supply of employment in the economy and matching skilled workforce. When the economy avails more jobs, and the workforce has skills that match these jobs, the unemployment rate decreases. However, in the case of Togo, where economic growth is stable over the past ten years, the decrease in unemployment would mean an increased number of poor workers.

Figure 1: Equation 3.2 graphs



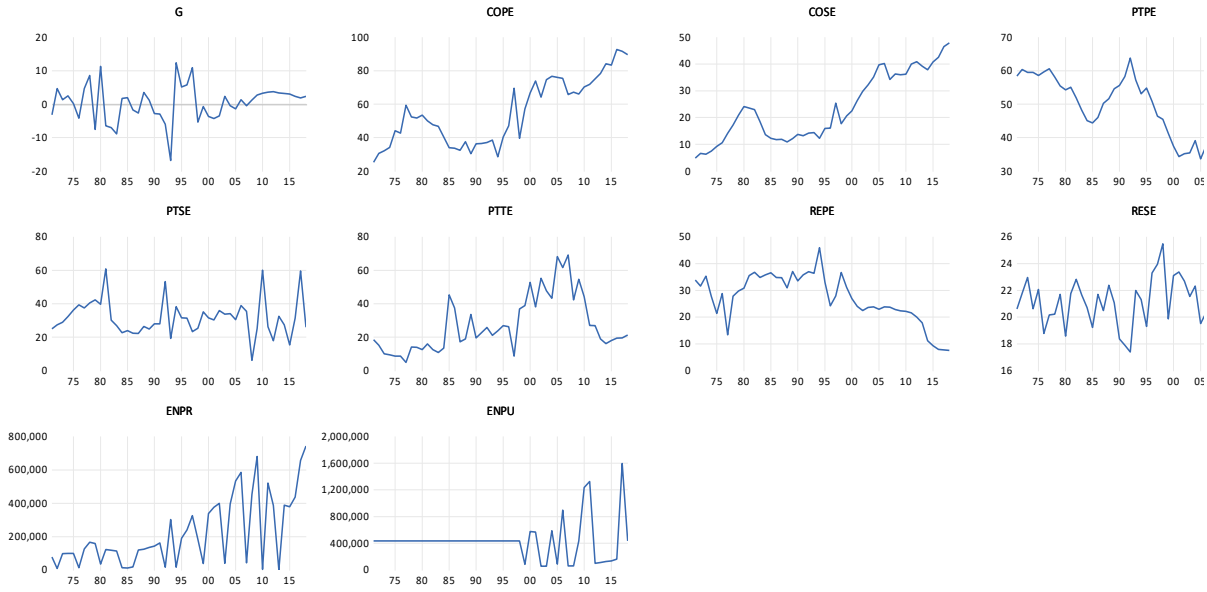
The graphical representations of the variables in equation 3.3 in Figure 2, show one variable reflecting a downward trend, the labor force participation, while the other variables oscillate around a mean. The graph for labor force participation shows a downward trend that could mean that the proportion of the workforce staying home, or disabled or pursuing education is on the rise. These categories are not economically active, which can explain the decline of their participation in economic activity.

Figure 2: Equation 3.3 graphs



The graphical presentations of the variables in Equation 3.4 in Figure 3, generally show a mixed trend with completion rate in primary and secondary education and the enrolment rate in private school following an upward direct relationship, the pupil-teacher ratio in primary and tertiary education, the repeaters rate in primary education reflecting an inverse relationship. The completion rate increase while the enrolment in private school increases can imply an increased availability and reliance of Togolese households on private schooling. The decline in pupil-teacher ratio and repeaters in primary education shows an increased quality of education provided in primary education.

Figure 3: Equation 3.4 graphs



The descriptive statistics as shown in Table 1 describe the features of the variables used in the study. The table provides measures of central tendency, dispersion, and normality. The Mean and Median describe the central tendency of the distributions. While the Mean is the average of the values of the distribution, the Median is the exact value at the center of the distribution. The Maximum and Minimum give an indication of the highest and lowest values of the distribution. The Standard deviation indicates the dispersion of the distribution around the Mean. When low, it means that most of the values are close to the Mean of the distribution and it is easy to make predictions. When high, it means that the values are spread over a large range, with outsiders that can affect the ability to predict values. The skewness and Kurtosis also provide information on the dispersion of the distribution. The Jarque-bera statistic and its probability values are of importance as it informs on the normality of the distributions. A Jarque-bera probability value above 5% means that the distribution is normally distributed. Taken individually, the enrolment rates in private and public education are not normally distributed, nor are enrolment rate in tertiary education, government expenditure on education, government expenditure in tertiary education,

and pupil-teacher ratio in secondary and tertiary education. A transformation is therefore required on these variables to perform the statistical analysis.

The correlation matrix provided in Table 2 gives an indication of the correlation among variables, together with the probability values. There are different levels of correlations between the variables, including high ones which could indicate the presence of multicollinearity. The fact that regressors are correlated among themselves is not in general detrimental to the goodness of fit of a model (J Neter, MH Kutner, CJ Nachtsheim, 1996). However, to reduce it, three separate equations were modeled to reflect and respond to each research question. Also, the methodology used for the regression analysis ARDL ECM is appropriate as the variables need to be cointegrated, and it is therefore expected they are correlated. Moreover, the short-run and long-run analyses are based on the lagged differences of the variables. Finally, the study maintained all variables to avoid the omitted variables bias referred to in the literature review.

Table 1: Variables descriptive statistics

	G	COPE	COSE	DRPE	DRSE	ENGR	ENPE	ENPR	ENPU	ENSE	ENTE	GXED	GXPE	GXSE	GXTE	LFPR	PTPE	PTSE	PTTE	REPE	RESE	UNEM
Mean	0.4	55.3	23.5	41.0	35.4	54.2	105.2	221543	435080	31.3	4.8	20.2	45.3	26.7	21.7	82.2	48.0	31.7	27.4	27.1	21.0	2.1
Median	1.3	52.1	20.8	40.1	31.2	54.2	108.7	138862	434968	27.7	2.8	19.5	45.8	27.3	21.9	81.9	46.2	30.4	21.2	27.8	21.3	2.1
Maximum	12.4	92.7	47.9	73.4	75.3	80.3	127.4	743338	1595652	61.8	14.7	30.7	64.5	36.3	32.9	86.1	63.8	60.9	69.2	46.0	25.5	2.9
Minimum	-16.8	25.3	4.8	16.3	1.8	29.8	66.6	475	57817	7.0	0.5	16.0	24.5	14.3	14.4	78.9	33.6	6.2	4.9	7.6	17.0	1.6
Std.Dev.	5.4	19.5	12.5	13.4	17.4	12.4	16.6	204880	303940	15.3	4.2	3.0	10.0	5.1	3.2	2.0	8.7	10.8	16.8	9.0	1.8	0.3
Skewness	-0.4	0.3	0.4	0.3	0.4	0.1	-0.4	0.9	1.9	0.4	1.0	1.3	0.0	-0.5	0.5	0.1	0.1	0.9	0.9	-0.6	-0.3	0.3
Kurtosis	4.2	1.8	1.8	2.5	2.7	2.2	2.1	2.8	7.8	2.1	2.5	5.3	2.4	3.4	4.8	2.2	1.7	4.6	2.8	2.8	2.8	2.9
Jarque-Bera	4.0	3.5	4.1	1.0	1.6	1.3	3.1	6.4	73.6	3.2	7.9	23.6	0.8	2.6	8.0	1.3	3.7	11.7	6.5	2.6	0.6	1.0
Probability	0.138	0.175	0.128	0.596	0.441	0.512	0.216	0.040	0.000	0.204	0.019	0.000	0.670	0.278	0.019	0.521	0.158	0.003	0.040	0.271	0.730	0.622
Observations	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school.

Table 2: Correlation matrix

Variables	G	COPE	COSE	DRPE	DRSE	ENGR	ENPE	ENPR	ENPU	ENSE	ENTE	GXED	GXPE	GXSE	GXTE	LFPR	PTPE	PTSE	PTTE	REPE	RESE	UNEM
G	1.000																					
COPE	0.187	1.000																				
COSE	0.155	0.942	1.000																			
DRPE	0.166	-0.107	-0.077	1.000																		
DRSE	-0.241	-0.220	-0.133	0.291	1.000																	
ENGR	0.136	0.830	0.868	0.018	-0.008	1.000																
ENPE	0.131	0.869	0.886	-0.029	0.002	0.927	1.000															
ENPR	0.028	0.686	0.714	-0.211	-0.058	0.488	0.598	1.000														
ENPU	0.044	0.061	0.092	-0.053	-0.169	0.179	0.056	0.213	1.000													
ENSE	0.143	0.876	0.932	-0.029	-0.089	0.968	0.884	0.556	0.209	1.000												
ENTE	0.132	0.827	0.867	-0.058	-0.189	0.796	0.779	0.676	0.068	0.854	1.000											
GXED	-0.202	-0.017	-0.075	-0.110	-0.001	-0.058	0.057	-0.016	-0.013	-0.069	0.109	1.000										
GXPE	0.179	0.109	0.121	0.081	-0.078	0.093	0.114	0.075	-0.225	0.107	0.368	-0.148	1.000									
GXSE	-0.087	-0.200	-0.143	-0.204	-0.079	-0.221	-0.101	0.063	0.123	-0.199	-0.276	0.207	-0.642	1.000								
GXTE	-0.233	-0.458	-0.455	-0.171	0.129	-0.368	-0.427	-0.467	-0.207	-0.419	-0.535	0.019	-0.492	0.180	1.000							
LFPR	-0.172	-0.826	-0.862	0.138	0.205	-0.871	-0.897	-0.595	-0.091	-0.844	-0.782	0.119	-0.191	0.179	0.347	1.000						
PTPE	-0.070	-0.753	-0.777	-0.036	-0.022	-0.658	-0.739	-0.536	0.017	-0.737	-0.725	-0.267	-0.150	0.019	0.514	0.524	1.000					
PTSE	0.001	0.102	0.069	-0.130	-0.365	0.336	0.159	-0.161	0.452	0.281	0.034	0.124	-0.407	0.069	0.231	-0.181	0.128	1.000				
PTTE	-0.087	0.301	0.404	-0.295	-0.027	0.280	0.397	0.306	-0.079	0.367	0.348	0.266	0.102	0.325	-0.301	-0.198	-0.677	-0.018	1.000			
REPE	-0.250	-0.863	-0.754	0.174	0.361	-0.629	-0.627	-0.622	-0.055	-0.689	-0.759	0.130	-0.241	0.272	0.481	0.677	0.499	-0.044	-0.073	1.000		
RESE	-0.087	0.093	0.025	0.034	0.189	0.001	0.082	0.159	-0.021	-0.016	0.033	0.294	-0.034	-0.181	-0.052	-0.012	-0.209	-0.272	-0.116	-0.028	1.000	
UNEM	-0.055	-0.603	-0.703	0.095	0.165	-0.540	-0.573	-0.566	-0.051	-0.621	-0.707	0.122	-0.377	0.141	0.247	0.696	0.523	0.084	-0.425	0.519	0.056	1.000

Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school .

4.3 Unit root test

The results of the stationarity tests for each research question equation are shown in Tables 2, 3, and 4 below. The observation of the Augmented Dickey-Fuller (ADF) t-statistic probability value compared to a critical value of 0.05, indicates stationarity when the probability is below the critical value. The Null Hypothesis is the series has a unit root, and the Alternative is No unit root. A p-value below 0.05 means the Null hypothesis can be rejected, and the series is stationary since there is no unit root. For Equation 3.2 in Table 2 below, the unit root test reveals that there is stationarity at first difference for all the variables.

Table 3: Equation 3.2 Unit root test results

	T-statistic		Probability	
Series	I(0)	I(1)	I(0)	I(1)
G	-6.735043	-4.713055	0.0000	0.0004
ENPE	-1.936461	-3.734597	0.3132	0.0069
ENGR	-1.550497	-4.24505	0.4992	0.0017
ENSE	-0.307281	-4.471177	0.9152	0.0009
ENTE	1.246341	-4.823121	0.9979	0.0003
UNEM	-0.59264	-3.081848	0.8612	0.0358

Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate.

For Equation 3.3 in Table 3 below, the test reveals stationarity at level for all variables except for the Labor force participation series, which is stationary at first difference.

Table 4: Equation 3.3 Unit root test results

	T-statistic		Probability	
Series	I(0)	I(1)	I(0)	I(1)
G	-6.735043	-4.713055	0.0000	0.0004
GXED	-3.357632	-8.31217	0.0177	0.0000
GXPE	-4.100773	-10.66644	0.0023	0.0000
GXSE	-4.347424	-8.585064	0.0012	0.0000
GXTE	-2.932079	-5.279486	0.0494	0.0001
LFPR	0.545458	-4.56373	0.9863	0.0007
DRPE	-5.081459	-7.366637	0.0001	0.0000
DRSE	-3.360857	-4.90709	0.0179	0.0002

Note: G= GDP per capita; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education.

For Equation 3.4 in Table 4 below, the result of the unit root test reveals stationarity at level for Enrolment rate in the public sector, Repeaters rate in secondary school, and Pupil-teacher ratio in secondary school. All other variables are stationary at first difference.

Table 5: Equation 3.4 Unit root test results

	T-statistic		Probability	
Series	I(0)	I(1)	I(0)	I(1)
G	-6.735043	-4.713055	0.0000	0.0004
ENPU	-5.030435	-5.877101	0.0002	0.0000
ENPR	-0.507895	-10.55137	0.88 00	0.0000
COPE	-0.637758	-10.06156	0.8518	0.0000
COSE	-0.290727	-6.736891	0.9184	0.0000
REPE	-1.510814	-6.214922	0.5195	0.0000
RESE	-5.36367	-6.756217	0.0000	0.0000
PTPE	-1.227692	-5.784032	0.6548	0.0000
PTSE	-5.331422	-5.55036	0.0001	0.0000
PTTE	-2.436429	-9.394236	0.1376	0.0000

Note: G= GDP per capita; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school.

The unit root tests reveal the presence of series stationary at level and integrated of order I(0) and series stationary at first difference and integrated of order I(1). This result informs the use of the Pesaran Bounds cointegration test developed in the next session.

4.4 Cointegration

For the Pesaran Bounds test, when the F-statistic is higher than the critical value for the upper bound I(1) at 5% level of significance, the null hypothesis is rejected, meaning that there is cointegration. The results for the three research questions' equations are shown below.

Table 6: Cointegration results

	F-statistic	I(1) upper bound at 5% s.l.
Equation 3.2	7.128960	3.38
Equation 3.3	6.162278	3.21
Equation 3.4	5.591791	2.08

The above results indicate cointegration for each equation and inform the use of the ECM for estimation of the short-run and long-run dynamics.

4.5 Lag selection criteria results

To determine the optimal number of lags sufficient to model the relationships among variables, there is a need to select the optimal lag length. The results of the lag length procedure are as shown in Table 6 below.

Table 7: Lag length selection

Equation 3.2 — Endogenous variables: G ENPE ENSE ENTE ENGR UNEM

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-653.8951	NA	428488.2	29.99523	30.23853	30.08546
1	-521.5701	222.5467*	5463.884*	25.61682*	27.31991*	26.24841*
2	-500.9282	29.08631	12047.17	26.31492	29.47780	27.48787
3	-480.0627	23.71080	30925.06	27.00285	31.62552	28.71716
4	-448.6033	27.16949	66290.40	27.20924	33.29170	29.46491

Equation 3.3 — Endogenous variables: G GXED GXPE GXSE GXTE LFPR DRPE DRSE

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1105.955	NA	4.38e+11	49.50910	49.83029	49.62884
1	-982.8382	196.9866*	3.31e+10*	46.88170*	49.77236*	47.95931*
2	-941.6149	51.30011	1.19e+11	47.89400	53.35413	49.92948
3	-860.8000	71.83548	1.28e+11	47.14667	55.17628	50.14002

Equation 3.4 — Endogenous variables: G ENPU ENPR COPE COSE REPE RESE PTPE PTSE PTTE

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2359.138	NA	2.54e+33	105.2950	105.6965	105.4447
1	-2164.214	294.5517	4.13e+31	101.0762	105.4924*	102.7225
2	-2055.365	116.1056	5.51e+31	100.6829	109.1140	103.8259
3	-1851.228	127.0187*	5.68e+30*	96.05456*	108.5005	100.6943*

The optimal number of lags suggested by the estimation methods is 1. Although the AIC criterion indicates a lag 3 for equation 3.4, the Schwarz information criterion (SIC) indicates an optimal lag of 1, which is applied in all the model estimations in this study. Thus, according to the lag length criteria, the three models are sufficiently estimated with a lag length of 1.

4.5.1 Long-run estimates

Tables 7 to 9 present the long-run outputs of the ARDL estimation using the statistic software, EViews11. The model is specified using one lag for all variables as per the lag length selection performed earlier, and considers an unrestricted constant and no trend.

Table 8: Long-run estimates of Equation 3.8

Variables	Coefficient	Std. Error	T-statistic	Probability
ENPE	-0.0843	0.1581	-0.5337	0.5969
ENSE	0.2021	0.2874	0.7034	0.4865
ENTE	0.0759	0.4885	0.1554	0.8774
ENGR	-0.0751	0.3985	-0.1883	0.8517
UNEM	0.3476	4.6380	0.0749	0.9407

Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate.

Table 9: Long-run estimates of Equation 3.9

Variables	Coefficient	Std. Error	T-statistic	Probability
GXED	-0.4000	0.3269	-1.2237	0.2303
GXPE	0.1063	0.1563	0.6802	0.5014
GXSE	0.2074	0.2882	0.7196	0.4772
GXTE	-0.4745	0.4859	-0.9767	0.3363
LFPR	0.1258	0.5676	0.2217	0.8260
DRPE	0.0450	0.1151	0.3907	0.6987
DRSE	-0.0716	0.0739	-0.9700	0.3395

Note: G= GDP per capita; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education.

Table 10: Long-run estimates of Equation 3.10

Variables	Coefficient	Std. Error	T-statistic	Probability
ENPR	0.0000	0.0000	-1.4079	0.1706
ENPU	0.0000	0.0000	1.4631	0.155
COPE	-0.2615	0.3173	-0.824	0.4172
COSE	0.4862	0.3078	1.5795	0.1259
REPE	-0.4047	0.3097	-1.3068	0.2023
RESE	0.9709	0.7877	1.2325	0.2284
PTPE	0.2123	0.3395	0.6254	0.537
PTSE	-0.2573	0.1707	-1.507	0.1434
PTTE	0.0468	0.1122	0.4173	0.6798

Note: G= GDP per capita; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school.

The coefficients of the variables for the three equations are not significant, which indicates that they do not have a statistically significant impact on the GDP per capita growth in the long-run. This result joins the studies of Adeyemi & Ogunsola (2019), which long-run estimates between education variables and economic growth are not statistically significant, and Delgado, Henderson, & Parmeter (2012) who find that educational attainment bears little statistical significance on growth. Discrepancies on the

significance of the impact of education on economic growth can be attributed to differences in model specifications or measurement of education variables (Delgado et al., 2012). However, the signs of the coefficients give an indication of the direction of the relationship between GDP per capita and the variables. It is observed that an increase in the gross enrollment rate, especially in primary education, negatively impacts the GDP per capita growth; so are increases in government expenditure in education, including tertiary education. The results suggest that efforts made by the government in education weigh on the GDP and, eventually, the GDP per capita growth. Other variables with an adverse impact on the GDP per capita growth are the completion and repeaters rates in primary education and the pupil-teacher ratio in secondary school. These results suggest the negative impact of the cost implication of increased number of students in primary education on GDP per capita growth. The long-run coefficients are not statistically significant but the models being cointegrated, it is expected to see significant relations among the variables in the short-run estimations.

4.5.2 Short-run estimates

Tables 10 to 12 present the short-run coefficients for each equation estimated through the ECM. The tables have two parts. The first one being the short-run coefficients, and the second one being the estimation of the ECT (CointEq(-1)) that measures the speed of adjustment to which the short-run dynamics converge to long-run equilibrium.

Table 11: ***Short-run estimates of Equation 3.5***

Variables	Coefficient	Std. Error	T-statistic	Probability
D(ENPE)	0.7366	0.3207	2.2969	0.0277**
D(ENSE)	0.9547	0.4990	1.9132	0.0639*
D(ENTE)	-0.4407	0.4191	-1.0515	0.3002
D(ENGR)	-1.0099	0.6174	-1.6358	0.1109
D(UNEM)	1.4960	3.8294	0.3907	0.6984
CointEq(-1)	-1.1566	0.1606	-7.2008	0.0000***
C	6.1329	1.1755	5.2173	0.0000
R-squared	0.5947			
F-statistic	9.7832			
Durbin-Watson stat	2.0723			

, and *** indicate 10%, 5% and 1% level of significance, respectively. Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate.*

The short-run coefficient estimates present the dynamic adjustment of the variables. Short-run coefficients for D(ENPE) and D(ENSE) are statistically significant at 5% and 10% level. This indicates that changes in the enrolment rates in primary and secondary education are associated with an increase in the GDP per capita growth in the short run. The error correction term coefficient for equation 3.2 is significant and negative, indicating a long-run return to equilibrium of the dependent variable GDP per capita growth in this model, confirming the cointegration of the variables. The coefficient implies that

previous years' deviations from long-run equilibrium are corrected at an adjustment speed of 115% or 115% of deviation from long-run equilibrium is corrected each year.

Table 12: Short-run estimates of Equation 3.6

Variables	Coefficient	Std. Error	T-statistic	Probability
D(GXED)	-0.5228	0.3111	-1.6806	0.1029
D(GXPE)	0.0013	0.1097	0.0114	0.9910
D(GXSE)	0.0473	0.2131	0.2219	0.8258
D(GXTE)	-0.1176	0.2543	-0.4622	0.6471
D(LFPR)	0.7448	1.1542	0.6453	0.5235
D(DRPE)	0.0878	0.0510	1.7227	0.0949*
D(DRSE)	-0.0522	0.0438	-1.1906	0.2429
CointEq(-1)	-1.0785	0.1649	-6.5392	0.0000***
C	-1.1388	0.8062	-1.4125	0.1678
R-squared	0.6261			
F-statistic	7.9550			
Durbin-Watson stat	1.9300			

, and *** indicate 10%, 5% and 1% level of significance, respectively. Note: G= GDP per capita; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education.*

The short-run coefficient for D(DRPE) is statistically significant at 10% level. The results indicate that in the short run, a change of dropout rate in primary education is associated with an increase in the GDP per capita growth. The error correction term coefficient for equation 3.3 is significant and negative, indicating a long-run return to equilibrium of the dependent variable GDP per capita growth in this model. The previous years' deviations from long-run equilibrium are corrected at an adjustment speed of 107%.

Table 13: Short-run estimates of Equation 3.7

Variables	Coefficient	Std. Error	T-statistic	Probability
D(ENPR)	0.0000	0.0000	-3.3181	0.0026***
D(ENPU)	0.0000	0.0000	2.6162	0.0144**
D(COPE)	-0.0153	0.1777	-0.0863	0.9319
D(COSE)	1.0423	0.3860	2.7001	0.0118**
D(REPE)	-0.1459	0.2002	-0.7289	0.4723
D(RESE)	0.4810	0.4092	1.1755	0.2501
D(PTPE)	0.2627	0.3067	0.8565	0.3992
D(PTSE)	-0.1227	0.0779	-1.5745	0.1270
D(PTTE)	0.1563	0.0948	1.6499	0.1106
CointEq(-1)	-1.1789	0.1508	-7.8150	0.0000***
C	-11.3592	1.6310	-6.9646	0.0000
R-squared	0.6940			
F-statistic	8.1628			
Durbin-Watson stat	1.8536			

, and *** indicate 10%, 5% and 1% level of significance, respectively. Note: G= GDP per capita; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher*

ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school.

The short-run coefficient estimates for D(ENPR), D(ENPU), and D(COSE)are statistically significant at 1% and 5%. Changes in enrolment rates in private education and public education as associated with GDP per capita growth but with a low impact. Changes in completion rate in secondary school are, on the other hand, highly associated with an increase in GDP per capita growth in the short run. The error correction term coefficient for equation 3 is significant and negative, indicating a long-run return to equilibrium of the dependent variable GDP per capita growth in this model. The previous years' deviations from long-run equilibrium are corrected at an adjustment speed of 107%.

The ECT being above absolute 1 indicate an oscillatory convergence to equilibrium. This means that the speed of adjustment of the GDP per capita growth fluctuates around the long-run values before reaching equilibrium.

4.6 Causality

For this test, the study uses the error correction term (ECT) t-statistic significance level for the long-run causality, and the Pairwise Granger Causality for the direction of the causality in the short run. The long-run causality can be inferred from the t-statistic of the ECT, as shown in Tables 10 to 12. For the three Equations, the probability of the t-statistic is statistically significant at 1% level; thus, the null hypothesis of no Granger causality can be rejected, and it is possible to infer that there is a long-run causal effect among the variables of these equations.

The short-run causality tests are performed as shown in the Tables below. By observation of the results, if the p-value of the F-statistic is below 0.05, the null hypothesis is rejected, meaning that the regressor granger causes the dependent variable.

Table 14: Short-run causality test

	Null Hypothesis:	Obs	F-Statistic	Prob.
Equation 3.2	ENGR does not Granger Cause G	46	0.12622	0.8818
	G does not Granger Cause ENGR		1.99006	0.1497
	ENPE does not Granger Cause G	46	0.92529	0.4045
	G does not Granger Cause ENPE		3.39728	0.0431**
	ENSE does not Granger Cause G	46	0.07791	0.9252
	G does not Granger Cause ENSE		1.09525	0.344
	ENTE does not Granger Cause G	46	0.69307	0.5058
	G does not Granger Cause ENTE		0.02974	0.9707
	UNEM does not Granger Cause G	46	0.26674	0.7672
	G does not Granger Cause UNEM		1.28758	0.2869
	Null Hypothesis:	Obs	F-Statistic	Prob.
Equation 3.3	GXED does not Granger Cause G	46	0.41073	0.6659
	G does not Granger Cause GXED		1.39412	0.2596
	GXPE does not Granger Cause G	46	1.27145	0.2912
	G does not Granger Cause GXPE		0.19460	0.8239
	GXSE does not Granger Cause G	46	0.10063	0.9045
	G does not Granger Cause GXSE		0.26783	0.7664
	GXTE does not Granger Cause G	46	2.13299	0.1314
	G does not Granger Cause GXTE		0.16476	0.8487
	LFPR does not Granger Cause G	46	1.33889	0.2734
	G does not Granger Cause LFPR		3.55262	0.0378**
	DRPE does not Granger Cause G	46	2.22767	0.1207
	G does not Granger Cause DRPE		1.09287	0.3448
	DRSE does not Granger Cause G	46	1.38551	0.2617
	G does not Granger Cause DRSE		0.76953	0.4698
	Null Hypothesis:	Obs	F-Statistic	Prob.
Equation 3.4	ENPR does not Granger Cause G	46	0.69004	0.5073
	G does not Granger Cause ENPR		0.60365	0.5516
	ENPU does not Granger Cause G	46	0.05503	0.9465
	G does not Granger Cause ENPU		0.13894	0.8707
	COPE does not Granger Cause G	46	0.17199	0.8426
	G does not Granger Cause COPE		0.70756	0.4988
	COSE does not Granger Cause G	46	0.37899	0.6869
	G does not Granger Cause COSE		0.89965	0.4146
	REPE does not Granger Cause G	46	2.61671	0.0852*
	G does not Granger Cause REPE		0.39581	0.6757
	RESE does not Granger Cause G	46	0.65463	0.525
	G does not Granger Cause RESE		0.97327	0.3864
	PTPE does not Granger Cause G	46	1.34407	0.272
	G does not Granger Cause PTPE		2.04737	0.1421
	PTSE does not Granger Cause G	46	1.13642	0.3309
	G does not Granger Cause PTSE		0.14546	0.8651
	PTTE does not Granger Cause G	46	0.29273	0.7478
	G does not Granger Cause PTTE		1.23976	0.3001

, and *** indicate 10%, 5% and 1% level of significance, respectively. Note: G= GDP per capita; ENPE= primary education enrolment rate; ENSE= secondary education enrolment rate; ENTE= tertiary education*

enrolment rate; ENGR= gross enrolment rate; UNEM= unemployment rate; GXED= government expenditure on education; GXSE= government expenditure on secondary education; GXTE= government expenditure on tertiary education; GXPE= government expenditure on primary education; LFPR= labor force participation rate; DRPE= dropout rate in primary education; DRSE= dropout rate in secondary education; COPE= completion rate in primary education; COSE= completion rate in lower secondary education; REPE= repeaters rate in primary education; RESE= repeaters rate in lower secondary education; PTTE= pupil-teacher ratio in tertiary education; PTSE= pupil-teacher ratio in secondary education; PTPE= pupil-teacher ratio in primary education; ENPR= gross enrolment rate in private school; ENPU= gross enrolment rate in public school.

For equation 3.2, the result of the test shows that the coefficients of the explanatory variables on the GDP per capita growth are not statistically significant, so the null hypothesis of 'no Granger causality' cannot be rejected in the short run. None of the explanatory variables of equation 3.2 granger cause the GDP per capita growth in the short run. On the other hand, the GDP per capita growth granger causes the enrolment rate in primary education, confirming the drive to finance primary education in priority. Furthermore, it is observed from other pairs of the test that the gross enrolment rate, and enrolment rates in all education levels, granger cause unemployment in the short run.

For equation 3.3, the variables do not granger cause the GDP per capita growth in the short run. However, other pairs reveal that the GDP per capita growth and the government expenditure in tertiary education granger cause the labor force participation, and government expenditure in primary education granger causes the drop-out level in secondary education.

For equation 3.4, the repeaters rate in primary education granger causes the GDP per capita growth in the short run. Other pairs reveal that the pupil-teacher ratio in primary and secondary education granger cause the enrolment rate in primary education. Completion rate and repeaters rate in primary school granger cause completion rate in secondary school. Pupil-teacher ratio in secondary school granger causes the repeaters rate in secondary school. Finally, the pupil-teacher ratio in primary education granger causes the pupil-teacher ratio in tertiary education.

4.7 Models Diagnostics

To assert the robustness of the models, three diagnostic tests are performed, and the results are presented in the below Table.

Table 15: Diagnostic tests

	Equation 3.2	Equation 3.3	Equation 3.4
Serial correlation test	Rao F-stat Prob:	Rao F-stat Prob:	Rao F-stat Prob:
Normality test	Jarque-Berra Joint	Jarque-Berra Joint	Jarque-Berra Joint
Heteroscedasticity test	Chi-sq Prob: 0.3115	Chi-sq Prob: 0.1274	Chi-sq Prob: 0.1696

The diagnostic tests reveal no serial correlation for the three equations with an F-stat p-value above 0.05 that allows accepting the null hypothesis of no serial correlation. The residuals in the three equations are normally distributed, with a Jarque-Berra F-stat probability value above 0.05. There is no heteroscedasticity in all equations with the Chi-square probability value above 0.05 that allows accepting the null hypothesis of homoscedasticity. The diagnostic tests indicate that the models are robust.

4.8 Conclusion

The results and findings of the various estimation techniques used reveal a low impact of the education variables used on the GDP per capita growth. Some findings tend to indicate that education is not the driver of economic growth, but on the contrary economic growth is the driver of education. The next chapter will develop the conclusion and recommendations of the research following these results.

5 Chapter 5 Conclusion and recommendations

5.1 Introduction

This chapter provides an overview of the findings of the previous chapter and recommendations derived from them. As a reminder, this study's objectives are, in the case of Togo, to establish whether there is a relationship between education and economic growth, whether there are returns on education spending that translates into economic growth and whether or how quality education makes a difference.

As discussed in chapter 1, the engagement of world nations to fulfill the Sustainable Development Goal number 4 on education has led developing countries to focus on primary education, mobilizing most resources at the service of free primary education programs without real continuity at higher levels of education. This is the case in Togo where primary education is free since 2008, with rising government expenditure on primary education at the detriment of the secondary and tertiary levels. However, the gross enrolment rate has never been above 80% in more than 50years, and since the FPE implementation, the enrolment rate rose by 17% only. The quality of education has also been decreasing with less qualified teachers and poor infrastructures. Several studies have established a positive relationship between school attainment and economic growth and individual wealth improvement, where educated people are more likely to exit poverty (Pelinescu (2014), Breton (2013)), but others found no significant or low relationship (Benhabib and Spiegel (1994), Hoeffler (2002)). The determinants and factors influencing such a relationship are varied and their effects differ from a country to another. Each country is left to identify the formula that works for it to level up individuals of the economy out of poverty. The variable retained to proxy economic growth is the GDP per capita growth, and 21 education variables are retained to estimate the relationship, returns, and quality of education. The summary of the key findings is laid out in the next section.

5.2 Summary of key findings of the study

The study gathered data from 1971 to 2018 from the World Bank database. Unfortunately, there were several missing data, as noted in critics of researches on Sub-Saharan African countries (Bloom, Canning, and Chan (2006), Hoeffler (2002)), which led to the use of multiple imputation techniques to estimate the missing data. Following the resolution of this issue, the study employed statistical estimation techniques for time series, namely the stationarity test, cointegration test, long and short-run analysis, estimation through the ARDL Error Correction Model, as well as the causality test.

The initial observation of the series' graphs indicates a reducing unemployment level as the GDP per capita growth remains almost constant, a reducing labor force participation rate while the government expenditure is stable. These observations suggest that there is no evidence of skills-shortage in the country but confirm the increased number of poor workers. Also, these observations provide evidence of a higher proportion of the workforce not engaged in economic activities such as the disabled or students. The data show a stable dropout rate, higher enrolment and completion rates, reduction of repeaters, and pupil-teacher ratios, especially in primary education, which indicate an improvement in the supply of quality education.

The ADF unit root test conducted demonstrates that the series are stationary at level and first difference, and therefore, are integrated of order one I(1) and zero I(0). This has informed the use of the Pesaran Bounds cointegration test to investigate the existence of long-run or short-run relationships among the variables of the system. The results of the test confirm the existence of cointegration between the variables of the system. The GDP per capita growth is cointegrated in the long-run with the selected education variables. The performed ECM results indicate for the three equations, an error correction term of a negative sign which confirms a convergence to the equilibrium in the long-run following a shock in the short run.

The long-run estimates probability values indicate non-statistically significant relationships among the variables in the long run. However, the signs of the variables with negative coefficients suggest inverse relationships between variables related to higher investments in primary education such as government expenditure in education, enrolment and repeaters rates in primary education, and GDP per capita growth. The short-run estimates, on the other hand, show a statistically significant relationship between enrolment rates in primary and secondary education and GDP per capita growth, which is in line with the mainstream research findings on the positive impact of education on economic growth. The results also show a statistically significant relationship between enrolment rates in both private and public education, with GDP per capita growth, although with minimal impact. It is not possible with these results to infer the superiority of private education over public education, or vice versa.

The causality tests, combined with the estimation coefficients, reveal mainly that the GDP per capita is the driver of education in Togo, not the contrary, which confirms the existence of a reversed causality as identified in the literature review. This result indicates that individuals or families' investments in education are dependent on their revenues. Other results of the estimation performed suggest that the past values of the repeaters rate in primary education help to explain the GDP per capita growth, and in

the opposite direction. This confirms further the cost implication weight of investment in human capital. Then it is noticeable that enrolment rates at all levels of education granger cause unemployment, which shows the relationship between the two variables. The models' diagnostics performed indicate that there is no serial correlation for all three equations, and they are normally distributed and homoscedastic, implying the robustness of the models.

5.3 Recommendations

This study on the case of Togo tells us that education is not a primary driver for economic growth, but economic growth is a driver of investment in human capital. The results indicate a strong relationship in the short run between education and economic growth, and policymakers should, therefore, not neglect it. Evidence is also provided that education policies should not only focus on primary education but also on secondary education, which has a high positive impact on economic growth. The education system still relies heavily on Government expenditure, but currently, these are not efficient enough to foster a sustainable and successful education system that will lead to economic growth in the long term. The FPE program has shifted more expenditure on Primary education at the detriment of the secondary and the tertiary as mentioned earlier. And the proportion of expenditure dedicated to education has reduced over time. The quality of education is improving but not at a pace that will allow exit from poverty for the educated workforce. Policies should explore ways to provide education at a lower cost, notably through digital platforms as an example. The private sector should also compensate and support the efforts to provide quality education at all levels. The implementation of the FPE has borne fruits and needs to be pursued further to encourage students' transition to higher levels of educations. Given the evident lack of return of the current investment in human capital in Togo, it will be interesting to investigate the impact and the necessity for professional education to quickly put a skilled workforce on the market to produce and generate income.

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